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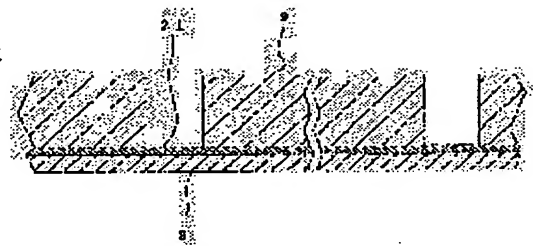
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(54) INK JET RECORDING HEAD AND MANUFACTURE OF ITS VIBRATING PLATE

(57)Abstract:

PURPOSE: To eliminate the pinhole of a vibrating plate at all and to improve the durability by forming a vibrating plate by connecting an island part formed by etching a metal thin plate to a polymer oriented film with an adhesive.

CONSTITUTION: A vibrating plate 7 is formed by etching a metal thin plate 20 laminated on the surface of a polymer oriented film 8 via an adhesive 21. The plate 7 has an island part 9 extended in the longitudinal direction of a pressure generating chamber, and displaced by a piezoelectric vibrator via the island 9. Since the island 9 is fixed to the film 8 via the layer of the adhesive 21, a stress at the end of the island part 9 is diffused by the adhesive 21, a stress concentration at the film is not only alleviated, but also the adhesive 21 of the surface becomes one type of the sealing material, and even if the film 8 is damaged or a defect exists, ink leakage can be prevented.



CLAIMS

[Claim(s)]

[Claim 1] The nozzle plate in which the nozzle orifice was drilled, and a pressure generating room, an ink feed hopper and the spacer that forms a common ink room, And the passage unit which joined the diaphragm equipped with the island section which counters said pressure generating room, and was formed, In the ink jet type recording head which consists of a piezoelectric transducer in the longitudinal-oscillation mode in which an ink droplet is made to breathe out in contact with said island section The ink jet type recording head characterized by joining with adhesives the island section in which said diaphragm etched and formed the metallic thin plate to a giant-molecule oriented film, and being constituted.

[Claim 2] The ink jet type recording head of claim 1 which has the criteria hole for positioning with which said diaphragm was drilled by press working of sheet metal.

[Claim 3] The ink jet type recording head of claim 1 to which the field which contacts said piezoelectric transducer of said diaphragm, and the non-contacting field of said piezoelectric transducer are connected through said giant-molecule oriented film and said adhesives.

[Claim 4] The ink jet type recording head of claim 1 said whose giant-molecule oriented film said metallic thin plate is polyphenylene sulfide resin in stainless steel.

[Claim 5] The ink jet type recording head of claim 1 which the giant-molecule oriented film has exposed to the periphery of said diaphragm.

[Claim 6] The manufacture approach of the diaphragm of the ink jet type recording head which consists of the process which joins a macromolecule oriented film to a metallic thin plate with adhesives, and forms a laminate material, the process which drills the criteria hole for positioning by press working of sheet metal, a process which fixes said laminate material to a pedestal with a photopolymer film, and forms necessary etching patterns, such as the island section, and a process etched until it penetrates said metallic thin plate.

[Claim 7] The process which joins a macromolecule oriented film to a metallic thin plate with adhesives, and forms a laminate material, The process which drills the criteria hole for positioning by press working of sheet metal, and said laminate material are fixed to a pedestal with the photopolymer film. The process which exposes the pattern of two or more diaphragms, and the etching pattern which penetrates said metallic thin plate to the perimeter of each of said diaphragm, and forms a slot in it, the process etched until it penetrates said metallic thin plate based on said etching pattern — since — the manufacture approach of the diaphragm of the becoming ink jet type recording head.

[Claim 8] The manufacture approach of the diaphragm of the ink jet type recording head of claim 7 equipped with the process which cuts said slot from said laminate material with a press, and cuts down a diaphragm.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Industrial Application] This invention relates to the structure and the manufacture approach of the ink jet type recording head which makes the piezoelectric transducer in longitudinal-oscillation mode a driving source, and the diaphragm which receives telescopic motion of a piezoelectric transducer in a detail more, contracts a pressure generating room and is expanded.

[0002]

[Description of the Prior Art] In order to aim at improvement in the recording density of a recording head, it is in the inclination for the pitch of a nozzle orifice train to become small, for this reason, anisotropic etching of the wafer of a silicon single crystal is carried out, the nozzle plate and diaphragm which were manufactured by this by other approaches are fixed with adhesives, a passage unit is constituted, transmit the variation rate of a piezoelectric transducer to this, and a pressure generating room is made to generate a pressure, and it is constituted so that an ink droplet may be made to breathe out from a nozzle orifice with this pressure.

[0003] Thus, if the array consistency of a pressure generating room becomes large, for the ** reason to which the width of face of a pressure generating room becomes very small, the heights prolonged in the longitudinal direction of a pressure generating room and the so-called island section will be formed in the plate in which elastic deformation is possible on the need of making the whole longitudinal direction of a pressure generating room transforming efficiently, and the variation rate of a piezoelectric transducer will be transmitted to the diaphragm through this island section.

[0004] While forming the layer of polymeric materials with dip coating, the roll coat method, a spray method, etc., etching metaled sheet metal into one front face of metaled sheet metal and forming the island section in it as such a diaphragm, what made the diaphragm section the polymeric-materials layer exposed by etching is proposed (WO 93/No. 25390).

[0005] however, the relation top which makes the diaphragm section the polymeric-materials layer formed by the film formation method and the diaphragm section — a pinhole — generating — easy — fear of leakage **** of the ink of a pressure generating room — moreover, reinforcement is holding fear of breakage low. Although carrying out film formation of the polymeric-materials layer more thickly is also considered in order to solve such a problem, the new problem that the rigidity of the diaphragm section becomes high and regurgitation effectiveness falls occurs.

[0006]

[Problem(s) to be Solved by the Invention] The place which this invention is made in view of such a problem, and is made into the purpose is offering the ink jet type recording head equipped with endurance and dependability while making the pinhole of a diaphragm there be nothing.

[0007]

[Means for Solving the Problem] In order to solve such a problem, it sets to this invention. The nozzle plate in which the nozzle orifice was drilled, and a pressure generating room, an ink feed hopper and the spacer that forms a common ink room, And the passage unit which joined the diaphragm equipped with the island section which counters said pressure generating room, and was formed, In the ink jet type recording head which consists of a piezoelectric transducer in the longitudinal-oscillation mode in which an ink droplet is made to breathe out in contact with said island section, said diaphragm joins to a macromolecule oriented film with adhesives, and constituted the island section which etched and formed the metallic thin plate.

[0008]

[Function] Since the macromolecule oriented film which has received rolling can be used as the diaphragm section at the time of processing of FIRUMUHE, the pinhole of the diaphragm section becomes that there is nothing and dependability improves.

[0009]

[Example] Then, based on the example illustrating the detail of this invention, it explains below. Drawing

1 and drawing 2 are what shows one example of the ink jet type recording head of this invention, respectively. The sign 1 in drawing Nozzle orifices 2 and 2, the nozzle plate in which 2 was drilled, and 3 the pressure generating rooms 4, 4, and 4 and the ink feed hoppers 5, 5, and 5 and the spacer which divides a reservoir 6, and 7 It is joined by adhesives and these nozzle plates 1 and a diaphragm 7 constitute the passage unit from a diaphragm by which this invention is characterized so that both sides of a spacing member 3 may be closed.

[0010] A diaphragm 7 is equipped with the island section 9 which etched into the front face of the giant-molecule oriented film 8 the metallic thin plate 20 by which the laminating was carried out through adhesives 21, and was formed in it and which is prolonged to the central field of the cross direction of the pressure generating room 4 at the longitudinal direction of the pressure generating room 4, and receives a variation rate with the piezoelectric transducer 11 later mentioned through this island section 9.

[0011] It is held in the vibrator unit hold hole 14 formed in the pedestal 13, the sign 10 in drawing is the vibrator unit constituted by fixing to a stationary plate 12 two or more piezoelectric transducers 11 and 11 which have longitudinal-oscillation mode, it is positioned so that the island section 9 of a diaphragm 7 may be contacted in a tip, and it is being fixed to the pedestal 13 through the stationary plate 12.

[0012] The ink supply pipe 15 linked to the ink tank which is not illustrated is formed in the pedestal 13, and the ink supply pipe 15 is opened for free passage by the common ink room 6 constituted by the spacer 3 through the ink feed hopper 32 of a diaphragm 7 in the tip. In addition, the sign 16 in drawing is a frame which fixes the passage unit constituted by the nozzle plate 1, the spacer 3, and the diaphragm 7, and a pedestal 13, and a sign 17 shows the substrate which fixes a head to carriage, respectively.

[0013] Drawing 3 and drawing 4 show one example of the above-mentioned diaphragm 7, and drawing 4 shows one diaphragm with which the condition that drawing 3 bundled up two or more diaphragms 7 and 7 and 7 to the laminate material of one sheet, and fixed them was separated from the laminate material again.

[0014] Below, the manufacture approach of the diaphragm mentioned above is explained based on drawing 5 . After applying adhesives 21 to one field of the metallic thin plate 20 with a thickness of 30 micrometers equipped with endurance to ink, for example, stainless steel, and pre drying adhesives, the macromolecule oriented film 22 with a thickness of about 4 micrometers, for example, the oriented film of polyphenylene sulfide (PPS) resin, is pasted up, and a laminate material is constituted (drawing 5 (I)).

[0015] This laminate material is cut in necessary size, an oban is started, and the through-holes 33, such as the holes 24 and 24 used as the criteria at the time of etching pattern exposure, the criteria holes 25, 26, 27, and 28 for positioning when setting to a press, the criteria holes 30 and 31 for positioning as an independent diaphragm 7 cut from the oban, and the hole 32 used as an ink feed hopper, are beforehand drilled by press working of sheet metal (drawing 5 (II)).

[0016] Subsequently, it sets to glass substrate B so that the metallic thin plate 20 of a laminate material may serve as a front face, the photopolymer film F is stuck on the front face of a metallic thin plate 20 so that an edge may reach the front face of glass substrate B, and it fixes that Film F is also about the whole laminate material to glass substrate B.

[0017] By taking such a process, it becomes possible to substitute the adhesion process of the photopolymer film F, and immobilization in glass substrate B of a work piece for one process. Moreover, although it is necessary to protect the end face of this hole from an etching reagent since the hole is beforehand formed in the laminate material of press working of sheet metal, as compared with a liquid photoresist, deformation of the hole at the time of etching can be certainly prevented by use of the high resin film of the protection capacity over an etching reagent.

[0018] In this condition, the mask in which the pattern which should be etched was formed is positioned using the criteria holes 24 and 24, and the photopolymer film F is exposed. By this, the apertures W and W for etching will be formed by the small relative error as much as possible to the criteria holes 24 and 24 correctly drilled by press working of sheet metal (drawing 5 (III)).

[0019] Subsequently, by etching a metallic thin plate using these apertures W and W, a metallic thin plate will be removed, adhesives 21 will be exposed, and the island section 9 surrounded by the fields D

and D used as the diaphragm section will be formed (drawing 5 (IV)).

[0020] It is an above-mentioned etching process, drawing 3 shows the large-sized structure after etching termination, and this example sets it, it etches so that the metallic thin plate 20 around each diaphragms 7, 7, and 7 may be penetrated to compensate for formation of the island sections 9 and 9, and the slot 34 of only the macromolecule oriented film 22 is formed, and each diaphragms 7 and 7 and 7 are connected through the macromolecule oriented film 22.

[0021] In the phase which etching ended, a laminate material is removed from glass substrate B, the criteria holes 25, 26, and 27 for positioning as an oban and 28 ** are inserted in the gage pin of a press, each diaphragms 7 and 7 and 7 are cut in a slot 34, and it kicks by OFF to each diaphragms 7, 7, and 7. Thus, since what is necessary is just to cut the macromolecule oriented film 22 since the metallic thin plate of a cutting field is removed by etching, the life of the die of a press will be extended.

[0022] The field where drawing 4 shows the cut diaphragm 7, and an oscillating unit contacts, i.e., the field shown with the signs 9, 9, 40, and 40 in drawing Since it insulates with the field where a metallic thin plate 20 is removed by etching, it is surrounded by the field of the shape of ** which adhesives 21 expose, and an oscillating unit does not contact electrically, The outflow of the current from the electrode of a dummy piezoelectric transducer can be prevented, and breakage can be prevented for the tip of a piezoelectric transducer 11, or the diaphragm by the electric corrosion again. In addition, the sign 41 in drawing is an aperture for absorbing vibration of the ink of ink ***** which exists in passage 3, etches only the metallic thin plate 20 of a laminate material, and is formed only as a layer of the macromolecule ductility film 22 and adhesives.

[0023] Drawing 6 shows the cross-section structure of an above-mentioned diaphragm, the island section 9 is being fixed to the front face of the macromolecule ductility film 8 through the layer of adhesives 21, and the diaphragm section which adhesives 21 become from the macromolecule oriented film 8 exposed to the front face is formed in the perimeter.

[0024] Thus, since the island section 9 is being fixed to the macromolecule oriented film 8 through the layer of adhesives 21, even if the stress in island section 9 tip should be spread with adhesives 21, the surface adhesives 21 should serve as a kind of sealant the stress concentration to a macromolecule oriented film is not only eased, but and a blemish and a defect should exist in the macromolecule ductility film 8, leakage **** of ink can be prevented.

[0025] Generally, on the production process, if the defect of a pinhole etc. exists, since a ductility film will be fractured by the production process, a product cannot be made to it. For this reason, if it is in the film which extended the fully examined ingredient, even if thickness becomes very thin with about several micrometers, there is almost no defect of a pinhole etc. and it is a very reliable ingredient. For this reason, a very reliable product can be offered as compared with the conventional method which forms the layer of a high polymer film in a metallic thin plate by the solvent KYASUTENGU method etc.

[0026] In addition, although an above-mentioned example sets and stainless steel is used as a metallic thin plate, it can etch and, moreover, the sheet metal of other adhesive high metals, for example, copper, nickel, iron, stainless steel, and silicon can be used.

[0027] Moreover, although polyphenylene sulfide (PPS) resin is used as a macromolecule oriented film Other polymeric materials which can be extended, for example, polyimide (PI) resin, polyether imide (PEI) resin, Boria MIDOIMIDO (PAI) resin, Pori Balaban acid (PPA) resin, BORISARUHON (PSF) resin, polyether sulphone (PES) resin resin, Polyether ketone (PEK) resin, polyether ether ketone (PEEK) resin, Polyolefine (APO) resin, polyethylenenaphthalate (PEN) resin, aramid resin, polypropylene resin, vinylidene chloride resin, poly car NETO resin, etc. can also be used.

[0028]

[Effect of the Invention] As mentioned above, the nozzle plate in which the nozzle orifice was drilled in this invention as explained, A pressure generating room, an ink feed hopper, and the spacer that forms a common ink room, In the ink jet type recording head which consists of a passage unit which joined the diaphragm equipped with the island section which counters a pressure generating room, and was formed, and a piezoelectric transducer in the longitudinal-oscillation mode in which an ink droplet is made to breathe out in contact with the island section Since the island section in which the diaphragm etched

and formed the metallic thin plate was joined to the macromolecule oriented film with adhesives. There is no defect, a macromolecule ductility film with high endurance can be used as a diaphragm, and surface adhesives can perform relaxation of stress concentration, and the closure of the minute crack of a film, and a reliable recording head can be realized. Moreover, since drilling by the press is possible in the phase of a laminate material, the hole for positioning criteria can be drilled in a high location precision, and improvement in assembly precision can be aimed at.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is the assembly perspective view showing one example of the ink jet type recording head of this invention.

[Drawing 2] It is the sectional view showing one example of the ink jet type recording head of this invention.

[Drawing 3] It is drawing showing the condition of having formed in the same laminate material two or more diaphragms used for the ink jet type recording head of this invention.

[Drawing 4] It is drawing expanding and showing a diaphragm same as the above.

[Drawing 5] Drawing (I) thru/or (IV) are drawings showing the production process of a diaphragm same as the above, respectively.

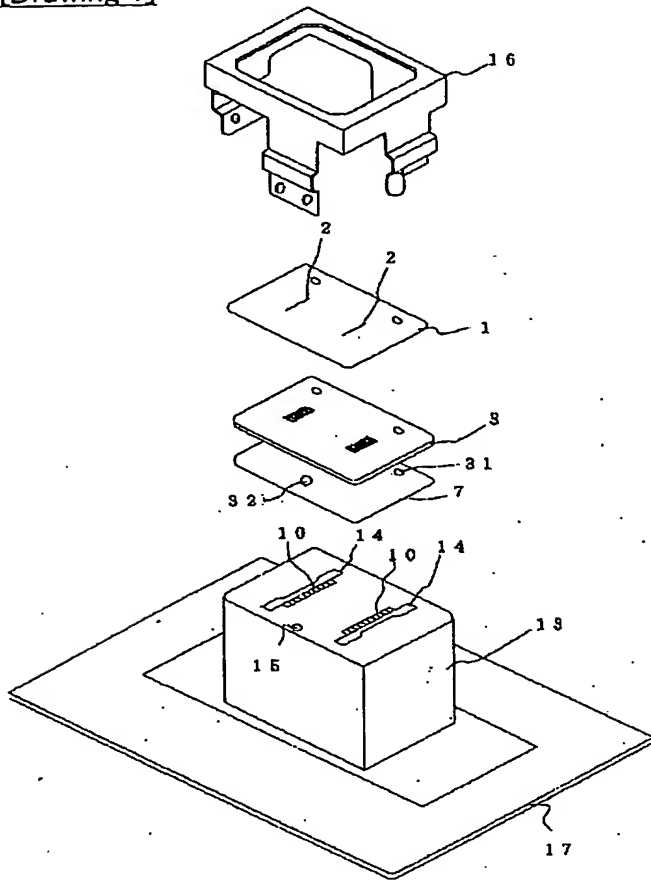
[Drawing 6] It is the sectional view in which expanding near the island section and showing the cross-section structure of a diaphragm same as the above.

[Description of Notations]

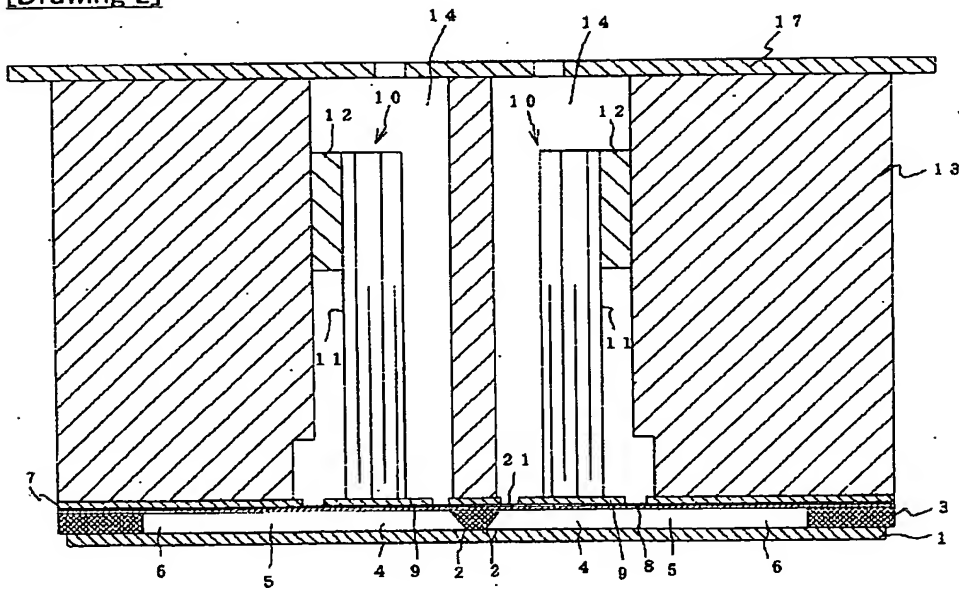
- 1 Nozzle Plate
- 3 Spacer
- 4 Pressure Generating Room
- 5 Ink Feed Hopper
- 6 Common Ink Room
- 7 Diaphragm
- 8 Macromolecule Oriented Film
- 9 Island Section
- 10 Piezo-electric Oscillating Unit
- 11 Piezoelectric Transducer
- 21 Adhesives
- 22 Macromolecule Oriented Film
- 24 Criteria Hole for Positioning for Exposure Mask Set
- 25-28 Criteria hole for positioning at the time of a press set
- 30 31 At the time of assembly
- 34 Slot for Press Cutting

DRAWINGS

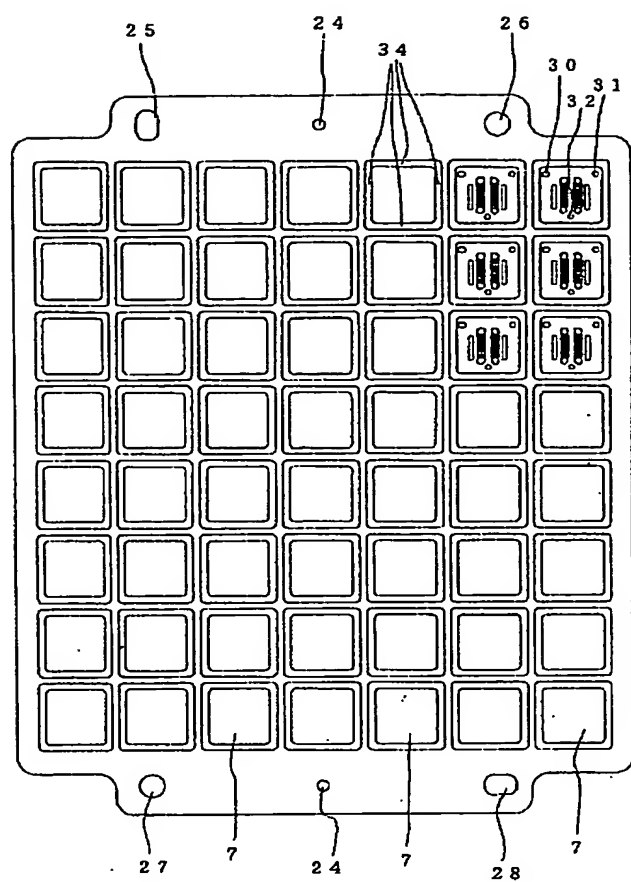
[Drawing 1]



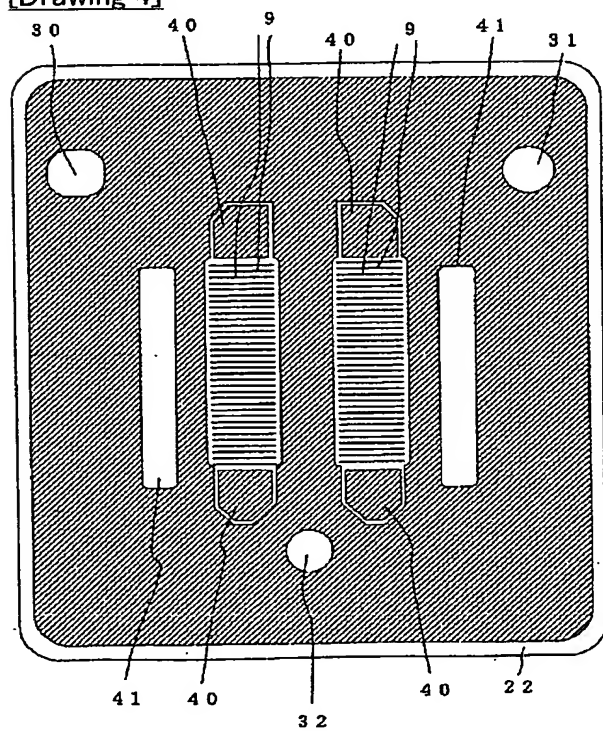
[Drawing 2]



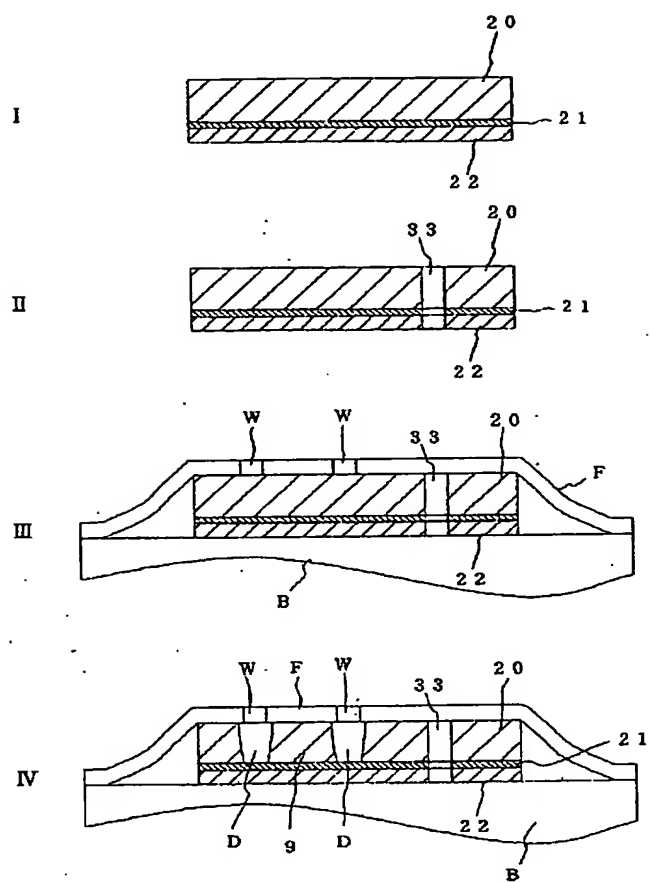
[Drawing 3]



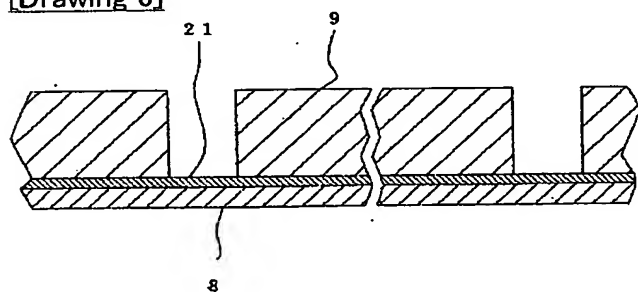
[Drawing 4]



[Drawing 5]



[Drawing 6]



CORRECTION OR AMENDMENT

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 [Procedure amendment 1]
 [Document to be Amended] Specification
 [Item(s) to be Amended] Claim
 [Method of Amendment] Modification
 [Proposed Amendment]
 [Claim(s)]

[Claim 1] The nozzle plate in which the nozzle orifice was drilled, a pressure generating room, an ink feed hopper and the spacer that forms a common ink room, and the passage unit which joined the diaphragm equipped with the island section which counters said pressure generating room, and was formed,

In the ink jet type recording head which consists of a piezoelectric transducer in the longitudinal-oscillation mode in which an ink droplet is made to breathe out in contact with said island section, The ink jet type recording head in which said diaphragm becomes from the plate which joined the metallic thin plate to the giant-molecule oriented film with adhesives, said metallic thin plate is etched into, and said island section is formed.

[Claim 2] The ink jet type recording head of claim 1 in which said diaphragm has the criteria hole for positioning drilled by press working of sheet metal.

[Claim 3] The ink jet type recording head of claim 1 to which the field which contacts said piezoelectric transducer of said diaphragm, and the non-contacting field of said piezoelectric transducer are connected through said giant-molecule oriented film and said adhesives.

[Claim 4] The ink jet type recording head of claim 1 said whose metallic thin plate is stainless steel and said whose giant-molecule oriented film is polyphenylene sulfide resin.

[Claim 5] The ink jet type recording head of claim 1 which the giant-molecule oriented film has exposed to the periphery field of said diaphragm.

[Claim 6] The process which joins a metallic thin plate and a macromolecule oriented film with adhesives, and forms a laminate material,

The process which drills the criteria hole for positioning by press working of sheet metal,

The process which fixes said laminate material to a pedestal with a photopolymer film, and forms necessary etching patterns, such as the island section,

The process etched until it penetrates said metallic thin plate since — the manufacture approach of the diaphragm of the becoming ink jet type recording head.
 [Claim 7] The process which joins a metallic thin plate and a macromolecule oriented film with adhesives, and forms a laminate material,

The process which drills the criteria hole for positioning by press working of sheet metal,
 The process which exposes the etching pattern for fixing said laminate material to a pedestal with the photopolymer film, and forming in the pattern of two or more diaphragms, and the perimeter of each of said diaphragm the slot which penetrates said metallic thin plate,

The process etched until it penetrates said metallic thin plate based on said etching pattern, since — the manufacture approach of the diaphragm of the becoming ink jet type recording head.

[Claim 8] The manufacture approach of the diaphragm of the ink jet type recording head of claim 7 equipped with the process which cuts said slot from said laminate material with a press, and cuts down each diaphragm.

[Procedure amendment 2]

[Document to be Amended] Specification

[Item(s) to be Amended] 0007

[Method of Amendment] Modification

[Proposed Amendment]

[0007]

[Means for Solving the Problem] In order to solve such a problem, it sets to this invention. The nozzle plate in which the nozzle orifice was drilled, and a pressure generating room, an ink feed hopper and the spacer that forms a common ink room, And the passage unit which joined the diaphragm equipped with the island section which counters said pressure generating room, and was formed, In the ink jet type recording head which consists of a piezoelectric transducer in the longitudinal-oscillation mode in which an ink droplet is made to breathe out in contact with said island section Said diaphragm consists of a plate which joined the metallic thin plate to the giant-molecule oriented film with adhesives, said metallic thin plate is etched, and said island section is formed.

[Procedure amendment 3]

[Document to be Amended] Specification

[Item(s) to be Amended] 0028

[Method of Amendment] Modification

[Proposed Amendment]

[0028]

[Effect of the Invention] As mentioned above, as explained, according to this invention, there is no defect, a macromolecule ductility film with high endurance can be used as a diaphragm, and surface adhesives can perform relaxation of stress concentration, and the closure of the minute crack of a film, and a reliable recording head can be realized. Moreover, since drilling by the press is possible in the phase of a laminate material, the hole for positioning criteria can be drilled in a high location precision, and improvement in assembly precision can be aimed at.